

The sub-Antarctic groups of Snares and Solander Islands are remote, dominated by predominantly foul weather and surrounded by pinnacles that rise unpredictably to form one of the most infamous ship graveyards in the world. Land Information New Zealand (LINZ), who have recently taken over responsibility for nautical charting from the Royal New Zealand Navy, has naturally been anxious to identify better and less expensive ways to undertake inshore surveys of such areas. In one of the first contestable surveys to be tendered, the SHOALS (Scanning Hydrographic Operational Airborne Lidar Survey) system played an integral part in meeting this requirement to ensure the safety of conventional hydrographic survey craft.

By Geraint West,
SHOALS Project Manager,
John E. Chance & Assoc. Inc.

Innovation and Integration

Shoals and a new era in New Zealand's charting programme

The Snares and Solander Islands lie 60 miles SW and 120 miles S of the New Zealand mainland respectively. As wildlife sanctuaries, the islands attract an increasing number of cruise ships which have had to use inadequate and out-dated charts. The climate limits surveying to only a few months so charting them was a real test of the industry's ability to mobilise and rapidly deploy integrated and diverse resources.

Contestability

Over recent years the New Zealand government has introduced funda-

mental changes to the way core government topographic and hydrographic services are provided. These changes have paved the way for private sector firms to work in markets that had previously been the exclusive domain of the public service and military, culminating in July 1998 when Land Information New Zealand (LINZ) introduced full contestability for most of the country's mapping and charting requirements. One of the first contracts to be tendered under this new structure was for the Snares and Solander islands. This was awarded to Hydrolink, an alliance

created to seamlessly provide the skills, expertise and experience required by today's maritime community. The four companies which comprise Hydrolink are Terralink NZ Ltd., Seaworks Ltd., Fugro Survey Pty. Ltd. and Hydrographic Sciences Australia (HSA) Pty Ltd.

The Challenge

The environment in which the survey was required is a demanding one; dominated by poor weather, rugged coasts and complex seabed topography. It is remote and ex-



The rugged coast of Solander Island

tremely difficult to access. In addition, the islands' status as wildlife reserves also meant that human impact had to be minimised. The challenge was to mobilise during an extremely short weather window a survey effort to collect a bathymetric dataset in dangerous uncharted waters and delineate inaccessible coastlines. LIDAR (Light Detection and Ranging) was quickly identified as crucial to such a project since it is able to meet all in-shore requirements while also providing safe clearance for conventional acoustic platforms to work in the deeper water. The Scanning Hydrographic Operational Airborne Lidar Survey (SHOALS) system which is owned by the US Army Corps of Engineers, and operated by one of the Fugro Group, John E. Chance and Associates Inc. (Lafayette, LA USA) was selected to fulfil this role.

Characteristics of SHOALS

SHOALS is a state-of-the-art LIDAR system, incorporating a 400 Hz laser which co-linearly scans pulses of infrared ($\lambda = 1064 \text{ nm}$) and blue-green ($\lambda = 532 \text{ nm}$) light across a pre-selected swath. The depth is calculated from the difference between the infrared returns from the sea surface and the blue-green from the seabed. Because a high confidence of hazard detection was required, a swath of 110 m with a dense grid of depths every 4 m was employed. For this project, a Twin Otter aircraft was selected. This is a versatile Short Take-Off and Landing (STOL) aircraft, ideal for remote op-

erations since it is commonly operated from jungle, dirt or ice airstrips. With a normal endurance in excess of five hours, the platform was extremely economic for the scenario, which required extended transits to the survey areas. Installation of ferry tanks more than doubles the aircraft's endurance making it deployable worldwide.

SHOALS v Conventional Surveys

The advantage of using SHOALS in an environment as hostile as the Snares and Solander Islands lies in its ability to rapidly chart shallow water areas close to rocky coasts where conventional ship methods are difficult and dangerous. Delineating and classifying features which are anomalous to the general trend of the seabed is one of the critical elements of any nautical charting survey. It proved to be a key role for SHOALS and one that it is optimised for. Solander, in particular, showed evidence of many small pinnacles, only a few metres in cross-sectional area, but tens of metres in vertical extent. Although some of these dangers were self-evident, the more dangerous ones rose from depths in excess of 30 m to within a few metres of the surface without breaking it. SHOALS was used to sweep many deep areas to locate any rocks which posed a danger to surface navigation.

Supporting Conventional Survey Platforms

As a consequence, the secondary role of SHOALS was to provide the sur-

veyor in charge and vessel master with sufficient data to be able to plan ship and boat sounding operations to ensure that all dangers had been located. This meant that the surveyor in charge was closely involved in the planning and conduct of SHOALS operations, which began as soon as tidal and geodetic control had been established. The strength of this approach was borne out by the fact that the conventional data collection segment of the project was given the go-ahead to proceed less than two days after completion of flying over Solander Island, when a preliminary SHOALS dataset was completed. The SHOALS surveyor was therefore able to highlight areas of both potential hazard and those where supplemental data were required; in addition it was also possible to provide a wealth of information on the general operating environment.

Quality Control

Quality control of the complexes of drying and breaking rocks in the in-shore zone required particular attention, as the lidar waveform characteristics of whitewater and land are extremely similar. Consequently almost every 'Land' return appearing within what was otherwise water had to be individually examined to determine whether it was white water or a drying feature. This was complicated by the fact that many conventional 'rules of thumb' were largely invalid, since pinnacles could be present almost anywhere and often apparently anomalous depths were more likely to be real, than noise in the water. Integration of datasets from vastly differing sensors also proved to be a new challenge and the value of powerful QC packages cannot be underestimated.

In Conclusion

Overall, the surveys of the Snares and Solander Island groups have proven the strengths and flexibility that a well-organised contractor can apply to a project of this size and complexity. By embracing specialist technologies such as SHOALS, as well as diverse resources and personnel from six different countries, this has developed a model of the innovative solutions which will increasingly be required by the marine com-



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The sub-Antartic Snares and Solander Islands lie near New Zealand are renown as wildlife sanctuaries

munity of the future. It should be clear that the foundation for this has been the close integration of SHOALS with conventional methods, allowing the completion of a survey of a particularly complex and hazard-

ous area in a timely and efficient manner. From the outset, the possibility that a survey vessel could fall victim to the same perils which it was charged with surveying, was a real concern. However, innovation and integration has ensured that this threat can be relegated to the history books - meanwhile hydrography in New Zealand looks to the future.

Biography

Geraint West served in the Royal Navy for 15 years with 12 of these as a hydrographic surveyor. The majority of this time was spent in a variety of ships conducting surveys worldwide, while between 1995 and 1997 he served on exchange to the US Navy at the Naval Oceanographic Office. His final appointment in the RN was as OIC of Surveys, onboard the Antarctic Ice Patrol Vessel, H.M.S. Endurance. He joined John E. Chance & Assoc. Inc. in 1998 as Project Manager for the SHOALS system. ■